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Research Article

Barn Owl (*Tyto alba*) Pellet Analysis Reveals Wider Distribution of the Pygmy White-toothed Shrew (*Suncus etruscus*) in Georgia

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Abstract

The pygmy white-toothed shrew (*Suncus etruscus*), one of the smallest mammals globally, has long been considered rare and poorly studied in Georgia. Traditionally under-recorded due to its small size and elusive behaviour, the species' presence has remained uncertain, with only a few historical or unverified records. In this study, we analysed barn owl (*Tyto alba*) pellets collected across eastern Georgia between 2023 and 2025 to assess the presence of *S. etruscus* in the region. From a total of 6,627 prey items extracted and identified, 41 individuals of *S. etruscus* were found in pellets from 12 different locations in Kakheti and Kvemo Kartli regions. These findings significantly expand the known distribution of the species in Georgia and suggest that it is more common in lowland habitats than previously believed. Given the barn owl's relatively small foraging range, the occurrence of *S. etruscus* remains in pellets is a reliable indicator of its local presence. Our results highlight the value of raptor pellet analysis in detecting elusive small mammals and suggest that *S. etruscus* may have been previously overlooked due to methodological limitations in traditional trapping surveys. This study provides a new foundation for understanding the distribution and habitat preferences of this poorly known species in the Caucasus.

Key words: *Suncus etruscus*, barn owl, pellet analysis, small mammals, Georgia, distribution

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Introduction

The pygmy white-toothed shrew (*Suncus etruscus*), weighing up to 3 g, is the world's second smallest mammal (Aulagnier et al. 2009). Its distribution spans from Portugal and Morocco to Vietnam and Kalimantan, yet in the Western Palearctic, it remains largely restricted to the Mediterranean region (Kryštufek and Vohralík 2001; Aulagnier et al. 2017). The fragmented nature of its known range likely reflects limited study rather than true rarity (Zaitsev et al. 2014).

In the South Caucasus, *S. etruscus* is poorly documented. In Russia, it was only recorded in 1985 from North Ossetia and Ingushetia (Alekseev and Sheftel 2018). Known localities in Türkiye lie far from Georgia's border (Kryštufek and Vohralík 2001; Özkoç et al. 2022), and although multiple records exist for Azerbaijan (Satunin 1915; Vereshchagin 1942; Goshunaliev 1990), the closest

observations are limited to the Shaki-Zagatala region (Ministry of Ecology and Natural Resources of Azerbaijan 2023). Records from Armenia near Lake Sevan (Yavruyan et al. 2005) are disputed (Alekseev and Sheftel 2018).

Despite over two centuries of mammal research in Georgia (Bukhnikashvili and Kandaurov 2002), data on *S. etruscus* have been sparse and fragmentary. Historical references from Tbilisi (Ognev 1928; Janashvili 1953; Papava 1953; Shidlovsky 2013) and Dusheti (Bukhnikashvili and Kandaurov 1998) lack preserved specimens. Verified records are limited to three individuals in Ilia State University collections (Bukhnikashvili 2004; Kandaurov et al. 2023), and two additional observations on iNaturalist (2025), one of which was confirmed genetically (Maglakelidze et al. 2024).

Conventional trapping is often ineffective for such tiny species (Kryštufek and Vohralík 2001). However, owl pellet analyses have proved useful in detecting *S. etruscus* (Popov et al. 2004; Coşkun and Kaya 2013; Nedyalkov et al. 2024). Since the barn owl (*Tyto alba*) became established in Georgia in the early 2000s and are now common in the lowlands (Bukreev 2003; Galvez et al. 2005; Malandzia and Ivanitskiy 2005; Kitel et al. 2025), their pellets provide a valuable tool for assessing small mammal distribution. This study presents new data on the occurrence of *S. etruscus* in Georgia based on extensive barn owl pellet analysis.

Material and methods

Barn owl pellets were collected across various locations in Georgia during the period from 2023 to 2025. A total of 6,627 prey items were extracted and identified, among which 41 individuals were determined to belong to *S. etruscus* (Fig.1). All *S. etruscus* specimens originated from the eastern Georgian regions of Kvemo Kartli and Kakheti (Table 1). Since the barn owl is a synanthropic species that frequently inhabits human settlements, pellets were collected from agricultural landscapes, typically from buildings such as abandoned structures or old churches (Fig. 2). To ensure safe handling, all pellets were sterilised in an oven at 160°C for 40 minutes following the procedure described by Orosz-Coghlan et al. (2022). After sterilisation, the pellets were softened in warm water, and skeletal remains (bones, skulls, and teeth) were extracted using forceps and other dissection tools in accordance with Mikusek (2005). Identification of *S. etruscus* was based on cranial characteristics following diagnostic keys in Kryštufek and Vohralík (2001) and Zaitsev et al. (2014). Whenever possible, skull measurements were taken using a caliper to the nearest 0.1 mm.

Results

A total of 41 individuals of *S. etruscus* were identified from barn owl pellets collected at 12 different localities in eastern Georgia (see Table 1). When combined with previously published records and visual observations uploaded to the iNaturalist database, the total number of known localities in Georgia increases to 19 (Fig. 3).

Due to the fragile nature of skulls after digestion and regurgitation, most specimens were incomplete, limiting the number of measurable cranial features. Only a small subset of skulls was sufficiently intact for morphometric

Figure 1. Skulls of *S. etruscus* extracted from Barn Owl pellets.

Table 1. Locations where Barn Owl pellets contained remains of *S. etruscus*.

Place, Region	Coordinates	Date(s) of Collection	Number of Individuals
Koghoto, Kakheti	42.014, 45.337	02 Sep 2023, 17 Sep 2023, 29 Dec 2023	10
Kondoli, Kakheti	41.941, 45.587	11 Sep 2023	6
Nazarlo, Kv. Kartli	41.410, 45.080	14 Jan 2024, 24 Feb 2024, 14 Jun 2024	6
Akhali Samgori, Kv. Kartli	41.593, 45.031	06 May 2024	5
Chailuri, Kakheti	41.694, 45.504	29 Dec 2024, 10 Oct 2024	4
Gremi, Kakheti	42.000, 45.656	17 Sep 2023, 19 Nov 2023	2
Jandari, Kv. Kartli	41.443, 45.155	14 Jan 2024	2
Tela, Kakteti	41.807, 46.157	14 Oct 2023, 20 Jan 2024	2
Gavazi, Kakheti	41.823, 45.911	20 Jul 2024	1
Dedoplitskaro, Kakheti	41.397, 46.291	22 Nov 2023	1
Pobeda, Kv. Kartli	41.497, 45.132	12 Nov 2023	1
Shiraki, Kakheti	41.381, 46.378	Dec 2024	1

analysis. The cranial measurements obtained from these specimens are presented in Table 2.

The overall proportion of *S. etruscus* among all prey items in the barn owl's diet in Georgia was 0.62%. When considering only the regions of Kvemo Kartli and Kakheti, this proportion slightly increased to 0.73%.

Figure 2. The habitat of *Suncus etruscus* near Koghoto village, Kakheti. Pellets were collected from the church shown. Photo taken on 11 Jun 2024 by N. Paposhvili.

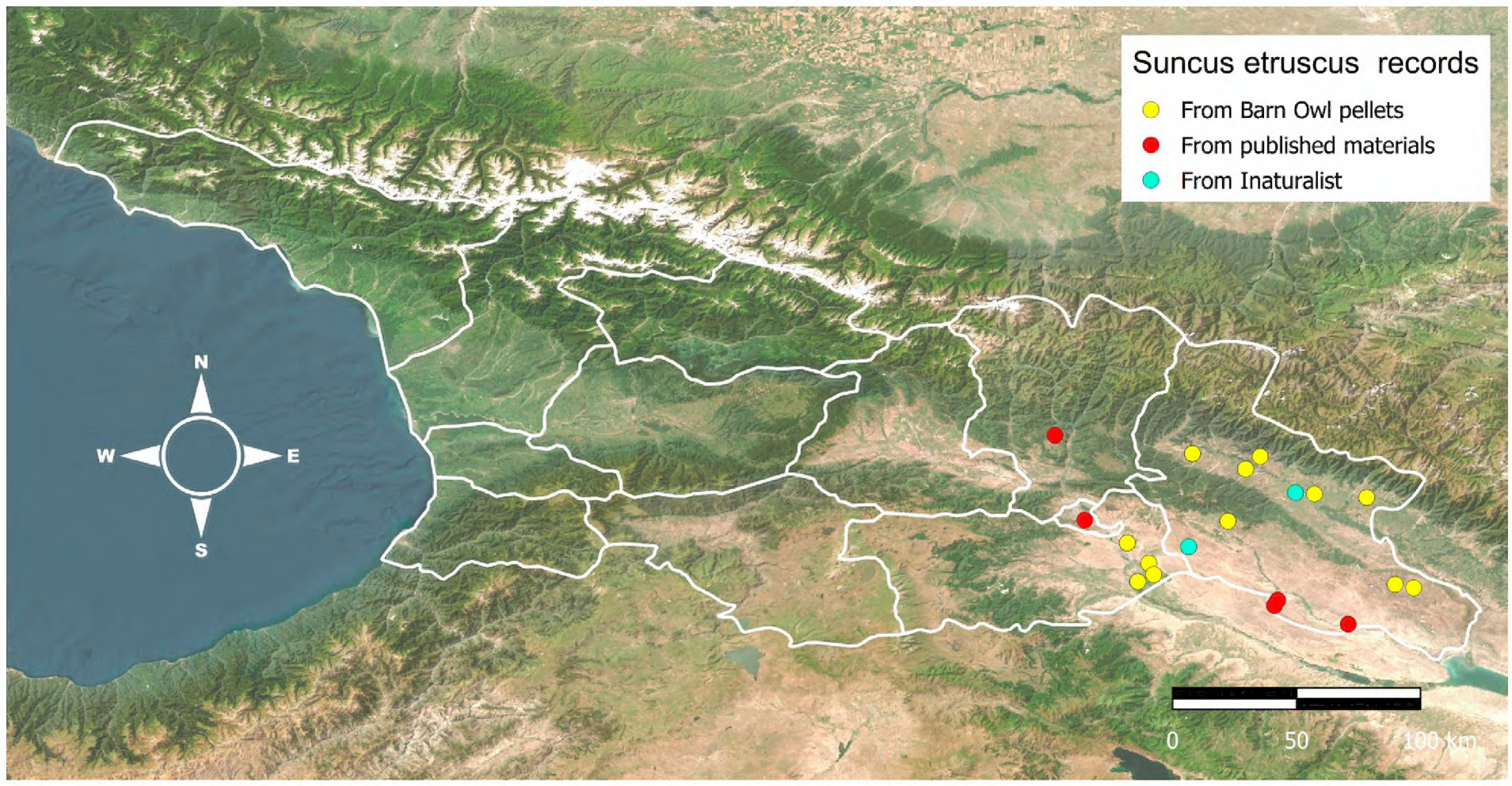

Figure 3. Distribution map of *S. etruscus* in Georgia based on both pellet analysis and earlier records.

Discussion

The skull measurements of *S. etruscus* specimens from Georgia fall within the known morphological ranges reported by Kryštufek and Vohralík (2001).

As a largely sedentary species, the barn owl typically hunts within a limited range around its nesting and roosting sites. In Israel, the average foraging

Table 2. Cranial measurements of *S. etruscus* specimens extracted from Barn Owl pellets (in mm).

Cranial characteristics	n	Range (Min-Max)	Mean
Condylobasal length	1	12,1-12,1	12,1
Braincase breadth	1	5,7-5,7	5,7
Rostral breadth	22	3,5-4,0	3,7
Coronoid height	23	2,5-2,9	2,7

distance rarely exceeds 2 km, with minor variations between sexes (Cain et al. 2023). This allows us to reasonably assume that the prey items found in owl pellets, including *S. etruscus*, were captured within the immediate surroundings of the pellet collection sites. Therefore, the spatial accuracy of the distribution map presented here is acceptable for this scale of analysis.

Although *S. etruscus* constitutes only a minor component of the barn owl's diet in Georgia, its presence in pellets from multiple sites clearly indicates that the species inhabits lowland regions of Kakheti and Kvemo Kartli. Nonetheless, the data should be interpreted cautiously. Our sampling was restricted to habitats preferred by barn owls—primarily open agricultural landscapes with grassy meadows. Consequently, areas where barn owls are absent, such as dry steppe, semi-deserts, or dense forests, were not surveyed. These environments could be inhabited by *S. etruscus*, but detection would require the analysis of pellets from other raptor species such as the little owl (*Athene noctua*), eagle owl (*Bubo bubo*), or tawny owl (*Strix aluco*), which occupy different ecological niches.

The confirmed occurrence of *S. etruscus* near Kajiri Lake in a hot, arid steppe habitat (Kandaurov et al. 2023) suggests that the species may inhabit environments beyond those frequented by barn owls. This highlights the importance of expanding pellet-based surveys to include other owl species and habitat types.

Our data on the distribution of of *S.etruscus* in Georgia are consistent with the statement by Nedyalkov at al. (2024) that the range of this species limited by +12°C annual isotherm. According to Tielidze et al. (2018), all of our confirmed records fall withing the 12-14 °C temperature zone. However, a historical record from Dusheti does not align with this pattern, as it is located in the cooler zone with an average annual temperature of 8-10 °C. No remains of *S. etruscus* were found in pellets collected from western Georgia, despite targeted sampling efforts. This absence may indicate either a true absence of the species in that region or be the result of methodological limitations. Although the mean annual air temperature in the western lowland exceeds 12 °C, this area is characterised by a humid subtropical maritime climate, which may not correspond to the ecological preferences of the species. Further targeted studies will be necessary to clarify this distributional pattern.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

DK collected and desiccated barn owl pellets, conceived an idea of the paper and wrote the manuscript; AB implemented the literature review and evaluated existing records.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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